EVAPORATION DEVICE FOR VOLATILE SUBSTANCES

Background of the Invention

This is a continuation-in-part of United States Application Serial no. 09/919,125 filed on July 31, 2001, and United States Application Serial no. 09/918,898 filed on July 31, 2001, which are continuation-in-parts of application serial no. 09/739,981 filed on December 18, 2000.

The present invention relates to a device to evaporate volatile substances, in particular insecticides and/or aromatics according to the introductory clause of claim 1. Devices for evaporation are generally known. For example, evaporation devices are known where a small plate is introduced into an evaporation device which is impregnated with an active ingredient and heated in order to evaporate the active ingredient. Furthermore a method is also known by which a container containing a volatile substance is introduced into a housing of an evaporation device. This container comprises a wick that conveys the substance to be evaporated by means of capillary action out of the container. Whereby the wick end protruding from the container is located next to a heating element such as e.g., a ceramic block, so that the substance is evaporated through the heat radiated by the ceramic block. The evaporated substance can escape from the housing into the environment through aeration slits in the housing.

Another example, an evaporation device for volatile substances, in particular insecticides and/or aromatics, is known from EP 0 943 344 A1 that includes a housing with a heating unit installed therein. The heating unit comprises a heating block made

2

of a ceramic material connected via electric lines to a connection plug located on the housing. An electrical resistance element is contained in the housing to heat the heating block. A container connected to the housing, for a substance to be evaporated, whereby a wick can be inserted into the container; with the container being connected to the housing. The wick is associated with the heating unit for the evaporation of the substance in the container by a wick end protruding from the container into the heating element. The evaporation device includes a plug-in part with a connection plug. The plug-in part is provided with threads and is inserted into the housing in which the container is disposed. Pin openings are provided on the housing into which snap-in pins are inserted in such manner that they engage the threads of the plug-in part. The distance between the heating unit carried by the plug-in part and a wick end protruding from the container can be changed by turning the plug-in part. In an embodiment of this system the plug-in part can furthermore be mounted in an eccentric manner in the housing, so the relative distance between the wick end and the heating unit can be changed in function of the desired degree of evaporation. The heating unit includes a ceramic block with an electric resistance element. Commercially available, relatively large as resistance elements are used. This leads to a relatively large heating unit and thereby also a great space requirement of the housing surrounding the heating unit and of the overall evaporation device. Such space-consuming evaporation devices are less attractive visually and can disturb the general visual effect, e.g. in a living room. In addition the design employs a great number of components which leads to large which is also relatively expensive and complicated to manufacture.

3

Furthermore the evaporation temperature cannot be sufficiently regulated because of the utilization of commercial resistance elements and this may have a negative effect on the flammability of certain parts or of the entire evaporation device, and possibly also on the degree of evaporation. A similar design with the above-mentioned disadvantages is also known from WO 98/58692 and EP 0 962 132 A1.

Accordingly, an object of the present invention is to create an inexpensive evaporation device for the evaporating of volatile substances, such as insecticides and/or aromatics, or relatively small dimensions in which the evaporation temperature can be accurately regulated according to the substance to be evaporated.

Summary of the Invention

The above objectives are accomplished according to the present invention by utilizing the electric resistance element to constitute a heating unit of small size and thereby to provide an overall miniaturized of the evaporation device, preferably, the heating element includes a rod-shaped resistance body coated at least in some areas with a resistance layer that is cut and/or ground into certain areas for the selection of a given resistance value corresponding to the composition of the substance to be evaporated.

A resistance element of this type for heating units can advantageously be of relatively small size so that the heating block, the heating unit, and the entire housing containing the heating unit may have a relatively small size. In this manner, miniaturized evaporation devices can be had with which one or two or more suitably adapted low-volume containers may be accommodated in the housing. Due to the reduced

expenditure for material and components, the miniaturized evaporation device can be produced relatively simply and inexpensively as a disposable item.

Another important advantage of an evaporation device according to the invention is that the evaporation temperature can be adjusted optimally according to the composition of the substance to be evaporated. Advantageously, the resistance layer for a given resistance value may be cut or ground in the element at different locations. The danger of flammability of the device is thus reduced and the possible negative effect on the degree of evaporation can be avoided.

There are, in principle, different ways for notching or grinding the resistance layer in order to provided a desired resistance value. In a preferred embodiment, the resistance layer is cut into and around the rod-shaped, preferably cylindrical, resistance body in a helicoidal form, such as by helicoidal laser cutting. With such a helicoidal cut the resistance value can be adjusted very precisely and easily for optimal evaporation performance.

The resistance layer can, in principle also be made of different materials, e.g. in form of a special metal layer. In an especially preferred embodiment, the resistance layer is however made in form of a metal oxide layer, preferably a nickel-chrome alloy layer. Such a metal oxide layer may be advantageously burned on thermo-chemically, e.g. by vacuum metallizing or cathodic sputtering in form of a thin layer. When the resistance layer has been applied, it is preferably subjected to a thermal process in order to stabilize the resistance layer. In addition, or alternately, the resistance body can be made of ceramic, preferably with a high content in AL_2O_3 (aluminum oxide), so that an especially good heat conductivity of the resistance body and thereby of the

resistance element overall is achieved. The content in AL_2O_3 depends on the actual installation conditions e.g. the housing material, the wick material, etc. being used.

Advantageously, metal caps may be placed on the ends of the coated, rod-shaped resistance body, which are preferably pressed on. An electrical line is preferably welded to each of these caps and is in turn connected to the connection plug. Copper wire with good electrical conductivity is preferably used for the electric lines. A good electrical contact with the resistance layer is furthermore easily and reliably achieved with the metal caps. In principle several ways exist for the installation of the rod-shaped resistance element on the heating block. In an advantageous embodiment, the rod-shaped resistance element can be inserted into a recess in the heating block. The resistance element is encapsulated in the recess using there in a highly heat-conductive material in order to fix the resistance element securely in the heating block. The encapsulating material may have a great heat conductivity may be a flame-resistant insulation cement. Furthermore a slit is preferably formed on either side of the resistance element, at the opposite ends of the recess, whereby the electrical lines can be routed out of the heating block to the connection plug. With a design of this type the resistance element can easily be inserted into the recess during assembly, e.g. also using a clamping lock, so that the resistance element cannot slip during the encapsulating process. In addition, electric lines can easily be curved in the direction of the connection plug. The electric lines can be insulated in a conventional manner.

An advantageous, compact design can be provided by making the length of the resistance element, as seen in the longitudinal direction of the recess approximately

equal to the width of the heating block. In this case, the electric lines may be bent at the caps approximately at right angles to the resistance element. The lines may then extend approximately parallel to each other and approximately in line with the two plug-in connections of the connection plug. Such an alignment of the electrical lines achieves an especially compact design of the heating unit, and this contributes in minimizing the size of the housing and the entire evaporation device.

In yet another aspect of the invention, a wick opening, preferably a passage hole or a traversing indentation on the edge of the heating block is formed into which the wick end extends is formed in the heating block next to the electrical resistance element. By means of such a wick opening a simple and reliable attribution of the wick end to the heating block and thereby to the heating unit is possible, and this contributes in ensuring effective evaporation.

An especially easy and rapid assembly of the heating unit in the housing is possible by providing the housing in at least two parts, an upper shell and a lower shell. The upper and lower shells can be connected to each other by means of a snap-in and/or clipping elements. Preferably, the connection means, e.g. snap-in elements, to are formed in the lower shell. At least one of the two shells is provided with aeration slits to let the evaporated substance escape into the environment. The aeration slits may be located above the wick end in the upper shell. Such a two-part housing can be produced very simply and inexpensively.

The connection plug preferably includes a base plate from which the plug pins extend to which the electric lines are connected. The base plate together with other components may be located in the housing and clamped between the upper shell and

the lower shell for a strong, and thus chatter-free fixed positioning. This makes a design of great value which is overall very stable, as well as secure in fixing the components in predetermined positions.

In order to give the evaporation device a visually more esthetic aspect, a decorative element can be attached to the upper shell. A surrounding edge border is preferably formed on the upper shell, to which such a decorative element can be snapped or clipped on. Such a decorative element could for example be in form of a flowering blossom.

Description of the Drawings

The invention will be more readily understood from a reading of the following specification and by reference to the accompanying drawings forming a part thereof, wherein an example of the invention is shown and wherein:

Figure 1 shows a schematic perspective view of the miniaturized evaporation device according to the invention;

Figure 2 shows a schematic perspective representation of the evaporation device of Figure 1 with the upper shell of the two-part housing lifted off;

Figure 3 shows a schematic perspective representation of a container, a wick and a heating unit of the evaporation device shown in Figures 1 and 2;

Figure 4 shows an enlarged top view of the heating unit of Figure 3;

Figure 5 shows a schematic lateral view of the heating unit of Figure 4;

Figure 6 shows a schematic, perspective representation of the heating unit of Figures 4 and 5;

8

Figure 7 shows an enlarged schematic top view of a resistance element with electric lines;

Figure 8 shows a schematic back view of the resistance element of Figure 7;

Figure 9 shows a schematic lateral view of the resistance element of Figure 7;

Figure 10 shows a schematic enlarged top view of a heating block made in the form of a ceramic body;

Figure 11 shows a schematic sectional view along line A-A of Figure 10; and,

Figure 12 shows a schematic lateral view of the representation of Figure 10.

Description of a Preferred Embodiment

Referring now in more detail to the drawings, the invention will now be described in more detail.

As can best be seen in Figure 1 is a miniaturized evaporation device 1 is illustrated with a housing 2 and a container 3 for a substance to be evaporated. The container 3 can be snapped onto the housing 2 using any suitable clip connection, for example.

As can be seen in from Figure 2, evaporation device 1 is illustrated for the sake of clarity without housing 2, wherein a wick 6 can be inserted by means of a wick holder 7 into the container 3. Wick 6 a wick end 8 from the container 3 into the housing 2, as can again be seen in Figure 2. Upper shell 4 is provided with aeration slits 9 in an area above the wick end 8 to allow the escape of the evaporated substance.

As can further be seen in Figures 2 and 3, evaporation device 1 comprises a heating unit 10 that is illustrated enlarged in Figures 4 to 6.

As best can be seen from Figures 4, 5, and 6, heating unit 10 comprises a ceramic block 11 in which an opening 12 is made. In each of the lateral sides of the block, a slit 13, 14 is provided. Figures 10 to 12 show ceramic block 11 in different views illustrating the geometry of the opening 12 as well as of the slits 13, 14. Thus opening 12, as seen in cross-section, is U-shaped. This shape is merely selected as an example. Ceramic block 11 preferably has a maximum width and length of e.g., 116 mm and a height of 9 mm.

A rod-shaped resistance element 15 is inserted into block opening 12. Resistance element 15 includes a resistance body 17 coated with a metal oxide resistance layer 16 (not shown in detail) to provide a heating unit 10 of small overall dimensions. To provide a predetermined resistance value, resistance layer 16 may consist of a metal oxide, e.g. a nickel-chrome alloy, which is cut into helicoidally, e.g. by laser spiral cutting. A helicoidal Cut 18 is thus produced around the rod-shaped cylindrical resistance body 17. Figures 7 to 9 show the resistance element 15 in different views, without attachment to a connection plug 26.

Resistance body 17 is preferably made of ceramic, with a given content of Al_2O_3 for the provision of good heat conductivity characteristics. For example, resistance body 17 has a length of approximately 10 mm and a diameter of approximately 3 mm. At each end of coated, cylindrical resistance body 17 a metal cap 19, 20 is installed, preferably pressed on. To these caps 19, 20 an electric line 21, 22, preferably a copper wire with insulation is welded to caps 19 and 20.

As can be seen in particular from Figures 4 to 6, the resistance element 15 is inserted into the opening 12, whereby the two electric lines 21, 22 are passed through

the slits 13, 14 out of the ceramic block 11. Following this the resistance element 15 is encapsulated in a highly heat conductive, flame resistant insulation cement in order to fix the resistance element 15 in the ceramic block 11 while maintaining its good heat conductivity.

As Figures 4 to 6 further show, the length of resistance element 15 in the longitudinal direction of opening 12 is approximately equal to the width of ceramic block 11. Electric lines are then angled approximately at a right angle to resistance element 15 and parallel to each other. The lines are in-line with two plug-in pins 24, 25 of connection plug 26 as they extend to a base plate 23 of connection plug 26. This provides for a design with overall little space requirements, making a miniaturized construction of evaporation device 1 possible, as shown in approximately actual size in the drawings of Figures 1 to 2.

As can further be seen in Figure 10, a circular wick opening 27 is provided in ceramic block 11 next to opening 12, into which wick end 8 extends in the assembled evaporation device, as can be seen in particular in Figure 2. In its assembled state, heating unit 10, as well as the base plate 23 of connection plug 26, is clamped between upper shell 4 and lower shell 5. As is shown merely as an example, a surrounding edge border 28 is formed on the upper shell, to which a decorative element with a corresponding counter-element can be snapped in, e.g. a decorative element in form of a flowering bloom (not shown).

While a preferred embodiment of the invention has been described using specific terms, such description is for illustrative purposes only, and it is to be

understood that changes and variations may be made without departing from the spirit or scope of the following claims.